

Grade 6 checklist

131 skills. Tick each one when you can do it. For grade 6 you need the skills for the grades below it too.

Cell biology

- ☐ **Write cell sizes in standard form** Use $1\text{ }\mu\text{m} = 10^{-6}\text{ m}$ and $1\text{ nm} = 10^{-9}\text{ m}$, e.g. $4\text{ }\mu\text{m} = 4 \times 10^{-6}\text{ m}$.
(Eukaryotes and prokaryotes)
- ☐ **Link a cell's structures to its function** e.g. a cell that needs a lot of energy has many mitochondria for respiration. (Animal and plant cells)
- ☐ **Explain how each adaptation helps the cell** Give the feature and what it does, e.g. the root hair gives a large surface area for absorbing water. (Cell specialisation)
- ☐ **Explain the importance of cell differentiation** It produces the different specialised cells a multicellular organism needs to carry out different functions. (Cell differentiation)
- ☐ **Convert units in magnification calculations** Put the image size and the real size in the same unit, usually μm , before dividing. (Microscopy)
- ☐ **Explain the reason for each aseptic step** e.g. flaming the inoculating loop kills microorganisms on it, so the culture is not contaminated. (Culturing microorganisms)
- ☐ **Calculate the area of a clear zone** Use πr^2 , halving the diameter to find the radius. (Culturing microorganisms)
- ☐ **Explain why body cell chromosomes are paired** One chromosome of each pair came from each parent, in the egg and the sperm. (Chromosomes)
- ☐ **Link genes to proteins** A gene is a small section of DNA that codes for a particular protein. (Chromosomes)
- ☐ **Describe therapeutic cloning and its advantage** An embryo is made with the same genes as the patient, so its stem cells are not rejected. (Stem cells)
- ☐ **Calculate surface area to volume ratios** Work out the total surface area and the volume, then write the ratio as $x : 1$. (Diffusion)
- ☐ **Explain how exchange surfaces are adapted** Large surface area, thin membrane, good blood supply and ventilation, e.g. alveoli and villi. (Diffusion)
- ☐ **Calculate a rate of change in mass** Change in mass $\div$ time, e.g. in g per minute. (Osmosis)
- ☐ **Explain gains and losses in mass** Tissue gains mass when the solution is more dilute than the cell contents, and loses mass when it is more concentrated. (Osmosis)
- ☐ **Explain osmosis in animal and plant cells** Animal cells can burst in water or shrivel in concentrated solutions; a plant cell wall stops the cell bursting. (Osmosis)
- ☐ **Compare diffusion, osmosis and active transport** Compare what moves, which way it moves relative to the concentration gradient, and whether energy is needed. (Active transport)
- ☐ **Explain why root hair cells have many mitochondria** More respiration releases more energy for the active transport of mineral ions. (Active transport)

Organisation

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- ☐ **Explain why a structure is an organ** Say that it is made of several different tissues that work together to carry out a specific function. (Principles of organisation)
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- ☐ **Explain enzyme action using lock and key** The substrate fits the specifically shaped active site, so each enzyme catalyses only one reaction. (The human digestive system)
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- ☐ **Explain how bile speeds up fat digestion** Bile is alkaline, so it neutralises stomach acid, and it emulsifies fat into small droplets with a larger surface area for lipase. (The human digestive system)
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- ☐ **Explain how blood vessels suit their functions** Arteries have thick muscular, elastic walls for high pressure, veins have valves, and capillary walls are one cell thick for diffusion. (The heart and blood vessels)
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- ☐ **Calculate the rate of blood flow** Rate of blood flow = volume of blood ÷ time, e.g. in cm³ per minute. (The heart and blood vessels)
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- ☐ **Explain how red blood cells are adapted** A biconcave shape gives a large surface area, and having no nucleus leaves more room for haemoglobin, which carries oxygen. (Blood)
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- ☐ **Describe how white blood cells defend the body** They engulf pathogens (phagocytosis), produce antibodies and produce antitoxins. (Blood)
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- ☐ **Explain how CHD damages the heart muscle** Less blood flows through the narrowed coronary arteries, so the heart muscle gets less oxygen for respiration. (Coronary heart disease)
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- ☐ **Explain the consequences of a faulty valve** A valve that does not open fully or that leaks makes the heart pump blood less efficiently, so less oxygen reaches the body. (Coronary heart disease)
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- ☐ **Describe how different diseases can interact** Immune defects increase infections, viruses can trigger cancers, immune reactions can trigger allergies, and severe physical illness can lead to depression. (Health issues)
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- ☐ **Calculate and interpret values from disease data** Read values from tables and graphs, calculate rates per 1000 people or percentages, and describe trends. (Health issues)
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- ☐ **Describe a correlation shown in a scatter diagram** Say whether the correlation is positive or negative and quote data from the graph. (Lifestyle and non-communicable diseases)
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- ☐ **Discuss human and financial costs of disease** Consider suffering and early death as well as treatment costs and lost work, for individuals, communities, nations and the world. (Lifestyle and non-communicable diseases)
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- ☐ **Explain how a secondary tumour forms** Cells break off a malignant tumour, travel in the blood to another part of the body and divide there to form a new tumour. (Cancer)
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- ☐ **Explain genetic risk factors for cancer** Some people inherit alleles, such as faulty BRCA alleles, that increase their risk of certain cancers. (Cancer)
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- ☐ **Explain how the mesophyll layers are adapted** Palisade cells are packed with chloroplasts near the top of the leaf; spongy mesophyll has air spaces for gases to diffuse through. (Plant tissues)
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- ☐ **Describe what guard cells and stomata do** Guard cells open and close the stomata to control gas exchange and water loss. (Plant tissues)
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- ☐ **Explain factors affecting the rate of transpiration** Higher temperature, lower humidity, more air movement and higher light intensity all increase the rate. (Plant organ system)
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- ☐ **Calculate the rate of transpiration** Rate = volume (or mass) of water lost or taken up ÷ time, e.g. from a potometer. (Plant organ system)
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Infection and response

- ☐ **Explain how a control method stops spread** Link the method to the route, e.g. washing hands removes pathogens, so they are not passed on by direct contact. (Communicable (infectious) diseases)
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- ☐ **Explain why TMV reduces plant growth** The discoloured parts of the leaves have less chlorophyll, so there is less photosynthesis and less glucose for growth. (Viral diseases)
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- ☐ **Explain why gonorrhoea is harder to treat now** Many strains are resistant to penicillin, so penicillin no longer kills them and other antibiotics must be used. (Bacterial diseases)
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- ☐ **Explain how vaccinating poultry protects people** Vaccinated chickens are not infected, so their meat and eggs are less likely to carry the bacteria. (Bacterial diseases)
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- ☐ **Explain why black spot reduces growth** Spotted, yellow and fallen leaves mean less photosynthesis, so less glucose is made for growth. (Fungal diseases)
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- ☐ **Explain how each control method reduces spread** Fewer mosquitoes, or fewer bites, means the protist is passed to fewer people. (Protist diseases)
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- ☐ **Explain how antibodies and antitoxins work** Antibodies bind to specific antigens on pathogens; antitoxins bind to the toxins made by bacteria and neutralise them. (Human defence systems)
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- ☐ **Explain how vaccination reduces spread in populations** If most people are immune, the pathogen is unlikely to reach unvaccinated people, so it spreads much less. (Vaccination)
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- ☐ **Explain why antiviral drugs are hard to develop** Viruses reproduce inside body cells, so drugs that kill them are likely to damage body tissues too. (Antibiotics and painkillers)
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- ☐ **Explain why a placebo is used** A placebo contains no drug, so comparing the two groups shows whether the drug itself has an effect. (Discovery and development of drugs)
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- ☐ **Explain why results are peer reviewed** Other experts check the method, results and conclusions before publication, so false or biased claims are less likely to be published. (Discovery and development of drugs)
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- ☐ **Describe how monoclonal antibodies are produced** Stimulate mouse lymphocytes, combine them with tumour cells, clone a single hybridoma cell, then collect and purify the antibody. (Producing monoclonal antibodies)
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- ☐ **Explain how a pregnancy test works** Antibodies bind to the hormone hCG in urine, so coloured beads collect at the test line only if hCG is present. (Uses of monoclonal antibodies)
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- ☐ **Explain the control line in a pregnancy test** Fixed antibodies there bind to the mobile antibodies, so a line shows that the test has worked. (Uses of monoclonal antibodies)
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- ☐ **Explain the effect of nitrate deficiency** Nitrate ions are needed for protein synthesis, so without them growth is stunted. (Detection and identification of plant diseases)
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- ☐ **Explain the effect of magnesium deficiency** Magnesium ions are needed to make chlorophyll, so leaves turn yellow (chlorosis) and photosynthesis falls. (Detection and identification of plant diseases)
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- ☐ **Explain how poisons and mechanical adaptations deter animals** They make the plant harmful, painful or unappealing to eat, so animals eat less of it. (Plant defence responses)
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Bioenergetics

- ☐ **Explain the results of a leaf starch test** Only parts of a leaf that had light and chlorophyll made glucose, which was stored as starch and turns iodine solution blue-black. (Photosynthetic reaction)
- ☐ **Explain why plants store starch, not glucose** Starch is insoluble, so it does not affect the movement of water by osmosis and it stays inside the cells. (Uses of glucose from photosynthesis)
- ☐ **Explain why plants need nitrate ions** Plants use glucose and nitrate ions to make amino acids, which are joined to make proteins. (Uses of glucose from photosynthesis)
- ☐ **Compare aerobic and anaerobic respiration** Compare the need for oxygen, the products and the amount of energy transferred. (Aerobic and anaerobic respiration)
- ☐ **Explain muscle fatigue in long exercise** Lactic acid builds up from anaerobic respiration, and over long vigorous exercise muscles stop contracting efficiently. (Response to exercise)
- ☐ **Explain why metabolism needs respiration and enzymes** Building new molecules uses energy transferred by respiration, and each reaction is controlled by enzymes. (Metabolism)
- ☐ **Describe what happens to excess protein** Excess proteins are broken down to form urea, which is excreted. (Metabolism)

Homeostasis and response

- ☐ **Apply the control system to new contexts** Pick out the stimulus, receptor, coordination centre, effector and response in an unfamiliar example. (Homeostasis)
- ☐ **Explain how impulses cross a synapse** A chemical is released, diffuses across the gap and binds to receptors on the next neurone, starting a new impulse. (Structure and function)
- ☐ **Explain how neurones are adapted** Long axons carry impulses a long way, branched endings connect to many neurones, and a fatty sheath speeds impulses up. (Structure and function)
- ☐ **Predict the effect of damage to a region** Link the damaged region to its function and describe the likely effect on the person. (The brain)
- ☐ **Explain why brain disorders are hard to treat** The brain is complex and delicate, so it is hard to reach one area without damaging others. (The brain)
- ☐ **Explain accommodation for near and distant objects** Ciliary muscles contract or relax, suspensory ligaments slacken or tighten, and the lens changes shape. (The eye)
- ☐ **Describe myopia and hyperopia and their correction** Short sight: light focuses in front of the retina, concave lens. Long sight: behind the retina, convex lens. (The eye)
- ☐ **Explain how sweating and vasodilation cool you** Both transfer more energy from the skin to the environment. (Control of body temperature)
- ☐ **Explain why the pituitary is the 'master gland'** Its hormones act on other glands, stimulating them to release their own hormones. (Human endocrine system)
- ☐ **Interpret blood glucose graphs** Describe and explain the rise and fall of glucose after a meal, with and without diabetes. (Control of blood glucose concentration)
- ☐ **Evaluate dialysis and kidney transplants** Weigh up time, diet, cost, rejection risk and donor shortages. (Maintaining water and nitrogen balance)

- ☐ **Interpret hormone graphs of the menstrual cycle** Match each hormone's peak to events such as ovulation and the build-up of the uterus lining. (Hormones in human reproduction)

- ☐ **Evaluate different methods of contraception** Compare effectiveness, side effects, STI protection, convenience and whether the method is reversible. (Contraception)

- ☐ **Describe the main stages of IVF** Give FSH and LH, collect eggs, fertilise them in the lab, then insert one or two embryos. (Hormones to treat infertility)

- ☐ **Define negative feedback** A change away from normal triggers a response that reverses the change, returning the level to normal. (Negative feedback)

- ☐ **Explain phototropism using auxin** Auxin moves to the shaded side, where cells elongate faster, so the shoot bends towards the light. (Control and coordination)

- ☐ **Give uses of gibberellins** Ending seed dormancy, promoting flowering and increasing fruit size. (Use of plant hormones)

Inheritance, variation and evolution

- ☐ **Explain why sexually produced offspring vary** Genetic information from two parents is mixed, so each offspring gets a different combination of alleles. (Sexual and asexual reproduction)

- ☐ **Explain why asexual offspring are clones** There is no fusion of gametes and no mixing of genetic information, and only mitosis is involved. (Sexual and asexual reproduction)

- ☐ **Explain why gametes have half the chromosomes** So that fertilisation restores the normal number of chromosomes. (Meiosis)

- ☐ **Describe development after fertilisation** The new cell divides by mitosis, the number of cells increases and the cells differentiate as the embryo develops. (Meiosis)

- ☐ **Explain why asexual reproduction is efficient** No time or energy is spent finding a mate, and many identical offspring can be produced quickly when conditions are favourable. (Pros and cons of sexual and asexual reproduction)

- ☐ **Name organisms that reproduce both ways** Malarial parasites, many fungi, and plants such as strawberries and daffodils. (Pros and cons of sexual and asexual reproduction)

- ☐ **Explain how a gene makes a protein** Each gene codes for a particular sequence of amino acids, which makes a specific protein. (DNA and the genome)

- ☐ **Give three uses of the human genome** Finding genes linked to disease, understanding and treating inherited disorders, and tracing past human migration. (DNA and the genome)

- ☐ **Explain how bases code for amino acids** A sequence of three bases codes for one amino acid, so the order of bases controls the order of amino acids. (DNA structure)

- ☐ **Extract information from family trees** Use the key and the phenotypes of parents and children to work out genotypes. (Genetic inheritance)

- ☐ **Predict disorder risks using Punnett squares** For example, two carriers of cystic fibrosis have a 0.25 probability of an affected child. (Inherited disorders)

- ☐ **Explain the 0.5 chance of a boy** All eggs carry an X chromosome and half of sperm carry X, half carry Y. (Sex determination)

- ☐ **Describe how mutations affect phenotype** All variants arise from mutations: most have no effect on the phenotype, some influence it and very few determine it. (Variation)

- ☐ **Explain how a feature evolved** Link variation to survival and reproduction, and the allele becoming more common over many generations. (Evolution)

- ☐ **Explain when populations become separate species** When they can no longer interbreed to produce fertile offspring. (Evolution)

- ☐ **Explain the problems caused by inbreeding** Breeds become prone to disease or inherited defects because variation is reduced. (Selective breeding)

- ☐ **Give benefits and concerns of GM crops** Higher yields, against concerns about wild flowers, insects and effects on human health. (Genetic engineering)

- ☐ **Describe embryo transplants** Split apart the cells of an early embryo before they become specialised and transplant the identical embryos into host mothers. (Cloning)

- ☐ **Explain why the theory was slowly accepted** It challenged the idea that God made all living things, there was too little evidence, and inheritance was not understood. (Theory of evolution)

- ☐ **Explain the impact of their ideas** Natural selection explains how the variety of life evolved and is the basis of modern biology. (Speciation)

- ☐ **Explain why Mendel's work was not recognised** Nobody knew about chromosomes, genes or DNA, so his results could not be explained, and few scientists read his work. (The understanding of genetics)

- ☐ **Explain how fossils support evolution** Fossils from rocks of different ages show how organisms have changed over millions of years. (Evidence for evolution)

- ☐ **Explain why the fossil record is incomplete** Early soft-bodied organisms left few traces, and most traces were destroyed by geological activity. (Fossils)

- ☐ **Explain uncertainty about how life began** So few traces of early life remain that scientists cannot be certain how life began. (Fossils)

- ☐ **Explain how a factor leads to extinction** Link the factor to fewer individuals surviving and reproducing until none are left. (Extinction)

- ☐ **Explain how resistant strains develop** A mutation makes some bacteria resistant; they survive the antibiotic and reproduce, so the resistant population rises. (Resistant bacteria)

- ☐ **Explain why the three-domain system was introduced** Evidence from chemical analysis showed that some organisms are more different than their structure suggests. (Classification of living organisms)

Ecology

- ☐ **Define a stable community** All the species and environmental factors are in balance, so population sizes stay fairly constant. (Communities)

- ☐ **Explain how an abiotic change affects a species** Link the factor to a life process, e.g. less light means less photosynthesis, so slower growth. (Abiotic factors)

- ☐ **Explain effects of new predators or pathogens** Prey may not be adapted to escape a new predator and organisms may have no resistance to a new pathogen, so numbers can fall fast. (Biotic factors)

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- ☐ **Explain adaptations to hot, cold and dry environments** Link each feature to heat loss or water loss, e.g. spines instead of leaves reduce water loss. (Adaptations)
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- ☐ **Estimate population size from quadrat data** Mean number per m² × total area in m². (Levels of organisation)
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- ☐ **Use a transect to investigate distribution** Place quadrats at regular intervals along a line and measure the factor at each point. (Levels of organisation)
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- ☐ **Explain the role of decomposers in cycling** Microorganisms break down dead matter and waste, respire and release carbon dioxide, and return mineral ions to the soil. (How materials are cycled)
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- ☐ **Explain how temperature, water and oxygen affect decay** They affect the enzymes and respiration of decomposers, so how fast they break down the material. (Decomposition)
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- ☐ **Calculate a rate of decay** Divide the change (e.g. in mass or pH) by the time taken, or use $1 \div \text{time for a timed end point}$. (Decomposition)
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- ☐ **Classify changes as seasonal, geographic or human** Seasonal changes follow the year, geographic changes vary from place to place, and some changes are caused by human activity. (Impact of environmental change)
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- ☐ **Describe a change in distribution from data** Say where the species is found now compared with before, using values from the map, table or graph. (Impact of environmental change)
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- ☐ **Explain why high biodiversity makes ecosystems stable** Species depend less on any one other species for food, shelter and maintaining the physical environment. (Biodiversity)
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- ☐ **Explain the effects of acidic gases** Gases such as sulfur dioxide dissolve in rain to make acid rain, which damages trees and makes lakes acidic. (Waste management)
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- ☐ **Explain how destroying peat bogs affects biodiversity** Less bog habitat means fewer of the plants, animals and microorganisms that live there can survive, so biodiversity falls. (Land use)
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- ☐ **Explain how deforestation increases atmospheric carbon dioxide** Burning releases carbon dioxide, microorganisms respire as the wood decays, and fewer trees remove carbon dioxide by photosynthesis. (Deforestation)
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- ☐ **Explain why species distributions change** As temperature or rainfall changes, species survive and breed in new areas and die out where conditions no longer suit them. (Global warming)
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- ☐ **Describe positive and negative human interactions** For example, replanting hedgerows is positive, while removing them to make bigger fields is negative. (Maintaining biodiversity)
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- ☐ **Describe how decomposers feed** They secrete enzymes onto dead matter, and the small soluble food molecules produced diffuse into them. (Trophic levels)
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- ☐ **Construct an accurate pyramid of biomass** Choose a scale, draw each bar with its width proportional to the biomass, and centre and label the bars. (Pyramids of biomass)
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- ☐ **Calculate the efficiency of biomass transfer** Efficiency = biomass at the higher level ÷ biomass at the lower level × 100. (Transfer of biomass)
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- ☐ **Explain how environmental change affects food production** If the rains fail or temperatures change, crops fail, which can lead to famine. (Factors affecting food security)
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- ☐ **Explain how limiting movement increases efficiency** Less energy is used for movement, so less energy is transferred to the environment and more of the food becomes biomass. (Farming techniques)
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- ☐ **Explain how controlling temperature increases efficiency** In warm surroundings less energy is transferred to the environment, so less food is respired to keep warm. (Farming techniques)

- ☐ **Calculate the percentage of food converted to biomass** $\text{Gain in mass} \div \text{mass of food eaten} \times 100$. (Farming techniques)

- ☐ **Explain how larger mesh nets help** Young, small fish escape, so they can grow and reach breeding age. (Sustainable fisheries)

- ☐ **Explain how fishing quotas help** Limiting the amount caught leaves enough adult fish to breed and replace those taken. (Sustainable fisheries)

- ☐ **Explain how GM crops can improve food supply** They can give more food or better nutrition, e.g. golden rice makes a substance the body uses to make vitamin A. (Role of biotechnology)

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